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(AVIATION)

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REPORT ON AIRPLANE RADIO RECEIVING SET, TYPE SCR-59, REMODELED

(EQUIPMENT SECTION TEST REPORT)

Prepared by Engineering Division, Air Service
McCook Field, Dayton, Ohio
October 4, 1921

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CERTIFICATE: By direction of the Secretary of War, the matter contained herein is published as administrative information and is required for the proper transaction of the public business.

REPORT ON AIRPLANE RADIO RECEIVING SET, TYPE SCR-59, REMODELED.

APPARATUS DEALT WITH.

The apparatus dealt with in this report is the airplane radio receiving set, type SCR-59. This set was intended originally to be used on airplanes where reception only was desired, and was to operate in conjunction with the airplane telephone set, type SCR-68, and the telephone set, type SCR-67. It was developed during the recent war by the Signal Corps, and was produced in quantities. The set box of this receiving set, designated as set box type BC-12, consists of a 3-tube receiving circuit using reactance coupling between the vacuum tubes.

NECESSITY FOR CHANGE IN DESIGN.

The SCR-59 receiver in its original form is very inefficient and requires the use of comparatively great power at the transmitting station to carry on communication over a given distance. The transmitting sets with which the Air Service is now supplied are of very low power. Due to the fact that the Signal Corps offers no immediate hope for the supply of any modern types of apparatus, it is necessary to improve the efficiency of existing types of apparatus so that the maximum possible range may be secured.

LIMITING FACTORS IN THE REDESIGN.

Due to limited funds available for this work it was necessary that the redesign should call for no great expenditure of time or money. It was considered necessary to limit the changes to those which could be easily accomplished by comparatively inexperienced instrument men, and to also limit the changes to those which could be made without making necessary additional apparatus outside of the original set box.

DESIGN ADOPTED.

The changes made in this redesigned receiving set are as follows:

(*a*) Substitution of transformer coupling for reactance coupling between the vacuum tubes.

(*b*) Addition of a tickler coil in the plate circuit of the detector tube.

(*c*) Substitution of nonrusting resistance wire on resistances, type RS-4, one of which is in the filament circuit of each vacuum tube.

The transformers used may be any type of audio frequency amplifying transformers such as made by several commercial firms, or the Signal Corps transformer type C-21. The use of transformer coupling between the tubes increases the efficiency of the receiving set to a marked degree. Signals which could not be heard when using the reactance coupling are made easily audible by means of transformer coupling. The use of a tickler coil in the plate circuit of the detector tube makes use of the Armstrong "feed-back" system and further amplifies the received signal. The use of nonrusting resistance wire on the resistance type RS-4 will correct a fault which has been present in a large number of the receiving sets, type SCR-59, issued to the service after a shelf life of about two years, namely, that of an opening in the filament circuit of one or more of the tubes due to the wire having rusted and broken.

The choke coils, type C-2, formerly used for coupling, have been removed from the set box and the transformers have been installed in their places. By means of a suitable mounting (the design of which depends upon the type of transformer used) the transformers are installed in the spaces made vacant by the coils. It is necessary to change the position of the antenna coil in the set box to permit the installation of the tickler coil. The method of mounting this coil is shown in figure 1. The construction of the tickler coil is shown in figure 2. The handle for operating this tickler coil has been extended through the front panel of the set box and a suitable knob has been provided to facilitate its operation. The knob for varying the antenna inductance has been removed due to the crowding on the face of the set box and a new type of handle has been substituted. The appearance of the set box after remodeling s shown in figure 3.

CONCLUSIONS.

The airplane radio receiving set, type SCR-59, when remodeled as described above, has greatly increased efficiency when used to receive damped wave signals. No reliable laboratory means for comparing signal intensity was at hand, so a flight test was arranged to learn the increase in range which might be expected when using the redesigned receiver. A spark transmitter working on reduced power was used at the ground station. A Curtiss JN-4 airplane was equipped with an SCR-59 receiver of the original type, and one of the remodeled type. A 200-foot trailing wire antenna was used. Signals from the ground station died out when the airplane was 1 mile from the transmitting station when using the standard model of the SCR-59 receiver. When using the remodeled SCR-59 receiver, but with the tickler coil set at zero coupling, the same signal was audible to a distance of 5 miles. When the tickler coil was adjusted for maximum sensitivity, the signal was audible at a distance of 18 miles. This serves to indicate the enormous improvement made by remodeling this set.

The addition of the tickler coil to this receiving set also makes possible the reception of undamped signals over the wave-length range of the set, which was not possible in the original receiver.

It is recommended that all airplane radio receiving sets, type SCR-59, be remodeled as described above before being sent from the various supply depots to the service. It is recommended that as soon as a sufficient number of receiving sets, type SCR-59, are remodeled they be sent to the service, and all unremodeled sets be returned to the supply depots, and that the original airplane radio telephone receiving set, type SCR-59, be considered obsolete.

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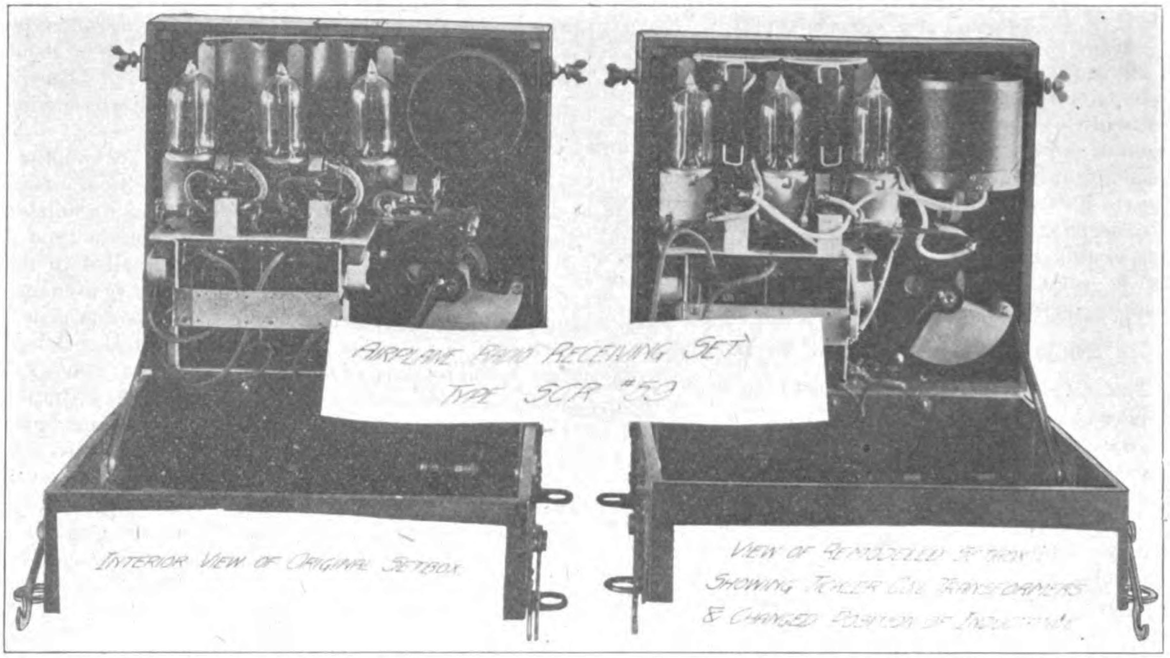
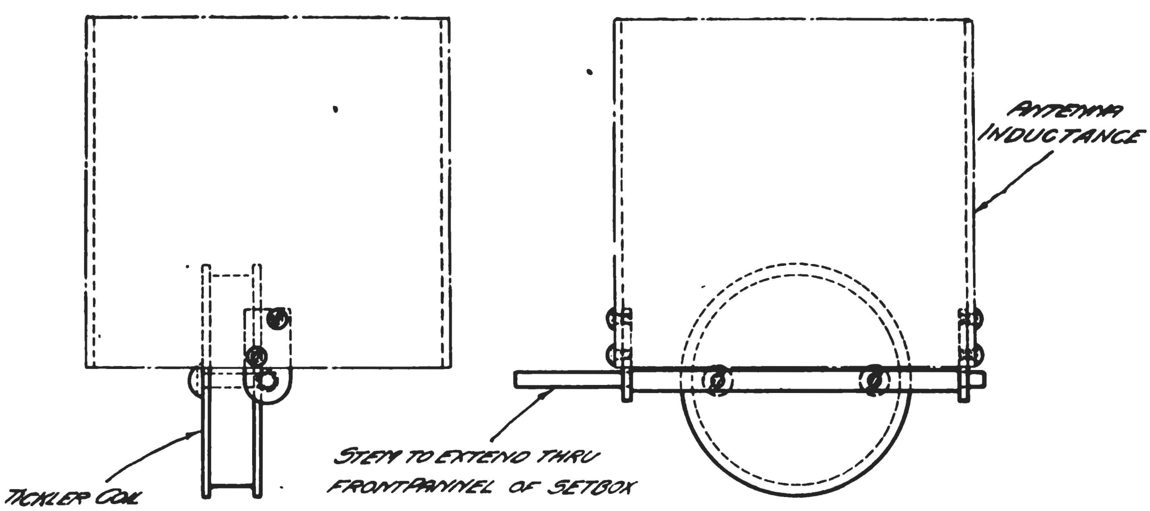


FIG. 1.



NOTE.—Tickler coil wound with 35 turns of No. 28 B. & S. gauge double cotton covered wire.

FIG. 2.—Method of mounting tickler coil in airplane radio receiving set, type SCR-59.

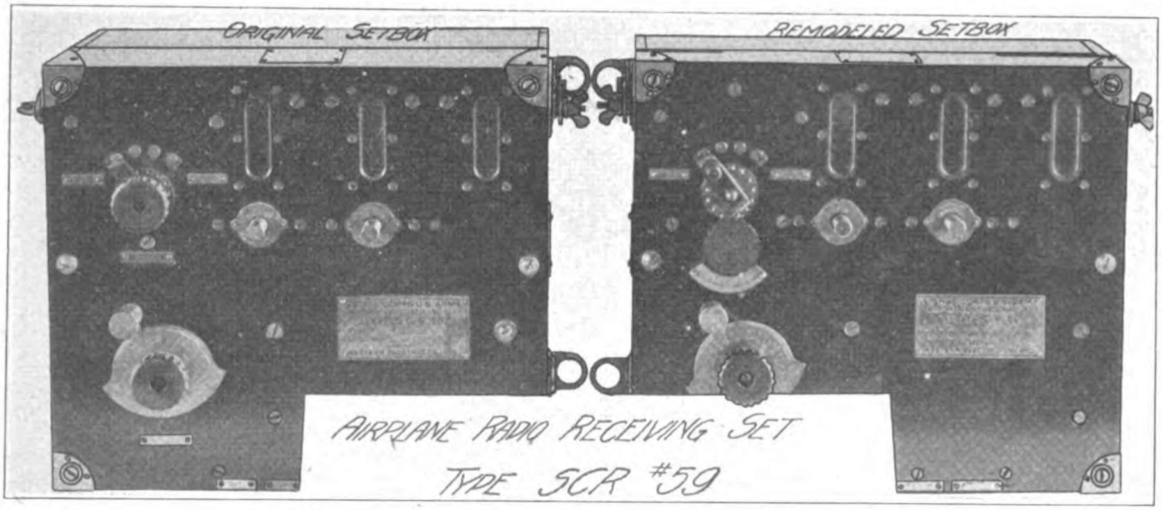


FIG. 3.

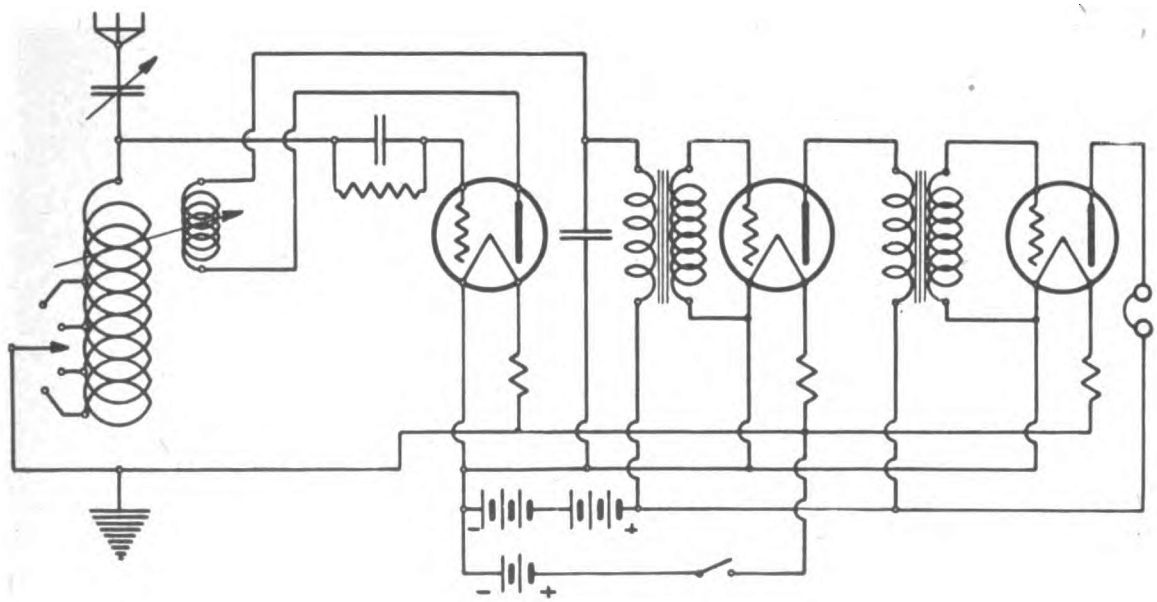


FIG. 4.—Wiring diagram of airplane receiving set, type SCR-59 remodeled.

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McCOOK FIELD REPORT, SERIAL No. 1760

AIR SERVICE INFORMATION CIRCULAR

(AVIATION)

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FIFTY-HOUR ENDURANCE TEST OF RAUSIE E-6 AVIATION ENGINE

(POWER PLANT SECTION REPORT)

▽

Prepared by Engineering Division, Air Service
McCook Field, Dayton, Ohio
October 13, 1921

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INDEX.

FIFTY-HOUR ENDURANCE TEST OF RAUSIE E-6 AVIATION ENGINE.

OBJECT OF TEST.

The object of this test was to determine the reliability and durability of a Rausie E-6, vertical, six-cylinder, water-cooled engine under practically service conditions.

SUMMARY.

This engine made a remarkably good showing throughout the 50-hour test. At no time was it necessary to make a forced stop because of minor or major failures. The power, fuel, and oil consumption remained unusually uniform. Not a single adjustment was made, except at one time to change the oil pressure slightly. The external appearance of the engine was very clean at the finish of the run, no cleaning having been done at any time.

The oil consumption was very low, the engine having consumed 12 gallons of oil for the entire test, which for the particular oil used amounted to less than 95 pounds.

The inspection after complete tear down brought to light the fact that very little wear had occurred at the various rubbing parts, despite the low oil consumption.

CONCLUSIONS.

The engine is recommended for training purposes with the changes suggested in this report.

DESCRIPTION OF ENGINE.

The Rausie E-6 aviation engine is a six-cylinder, vertical, water cooled engine manufactured by the Steel Products Co., Springfield, Ohio. The engine tested was the second design of the E-6 type, incorporating all the changes recommended in the Engineering Division report, serial No. 1430, Air Service Information Circular, Volume II, No. 191, on the first engine tested. A complete description of the redesigned engine will be found in the standard report which is now in the course of preparation, and in the report mentioned.

The characteristic features are: (*a*) Steel machined cylinders threaded at the upper end to screw into individual aluminum castings, these castings comprising the cylinder head, valve port, and water jackets, the lower ends of which fit against gaskets held in place by a flange on the steel cylinder; (*b*) A valve gear of novel design eliminating excessive side thrust on the valve stems and valve-stem guides.

METHOD OF CONDUCTING TEST.

In this test the usual calibration runs were made on the dynamometer.

The engine was mounted on a torque stand in the open air and fitted with a propeller designed to absorb the full power of the engine at the normal speed of 1,650 revolutions per minute.

The 50-hour endurance test was divided into ten periods of five hours each. The first half hour of each period was run at full throttle, and during the remaining four and one-half hours the engine was run at nine-tenths of full power, or practically 97 per cent, of the full throttle speed as determined by the propeller characteristics.

For a detailed description of the 50-hour endurance test and the methods used in computing the results, see power plant report, serial No. 1507.

INSPECTION AFTER TEST.

On completion of the test the engine was entirely disassembled and inspected. The condition of the engine on the whole was remarkably good.

The main and connecting rod bearings were in very good condition after a run of this duration. Figures 11 and 12 are photographs of the bearings.

The cam shaft showed wear on the noses of two cams due to insufficient lubrication caused by the lodging of dirt in the oil holes drilled in the face of the cams. See figure 9.

No. 6 exhaust cam follower was badly worn due to a lack of sufficient lubricating oil caused by dirt plugging the oil holes drilled in the face of the cam. See figure 9.

The cam shaft drive gears were all in excellent condition. The same was true of the accessories' drive gears.

The valve gear as a whole was in good condition. All valve stems were a very close fit in the guides. No valve springs were broken and all the valve springs retained practically their original compression. The exhaust valves and seats were badly pitted. All exhaust valves leaked more or less on the gasoline test at the completion of the test. No. 3 exhaust valve leaked gasoline freely. All the inlet valves were tight.

Valve timing and valve clearances before and after 50-hour endurance test.

	Cylinder No. 1.	Cylinder No. 2.	Cylinder No. 3.	Cylinder No. 4.	Cylinder No. 5.	Cylinder No. 6.
Inlet opens (before)	11° A. T. C.	11° A. T. C.	10° A. T. C.	11° A. T. C.	10° A. T. C.	11° A. T. C.
Inlet opens (after)	9° A. T. C.	10° A. T. C.	8° A. T. C.	10° A. T. C.	7° A. T. C.	10° A. T. C.
Inlet closes (before)	36° A. B. C.	38° A. B. C.	40° A. B. C.	39° A. B. C.	39° A. B. C.	39° A. B. C.
Inlet closes (after)	40° A. B. C.	40° A. B. C.	42° A. B. C.	42° A. B. C.	42° A. B. C.	42° A. B. C.
Exhaust opens (before)	45° B. B. C.	45° B. B. C.	43° B. B. C.	45° B. B. C.	45° B. B. C.	43° B. B. C.
Exhaust opens (after)	65° B. B. C.	53° B. B. C.	62° B. B. C.	55° B. B. C.	50° B. B. C.	58° B. B. C.
Exhaust closes (before)	17° A. T. C.	18° A. T. C.	16° A. T. C.	18° A. T. C.	17° A. T. C.	16° A. T. C.
Exhaust closes (after)	45° A. T. C.	32° A. T. C.	36° A. T. C.	35° A. T. C.	30° A. T. C.	37° A. T. C.
Inlet clearance (before)	0.020 inch	0.020 inch	0.020 inch	0.019 inch	0.019 inch	0.019 inch.
Inlet clearance (after)	do	0.021 inch	do	do	0.017 inch	Do.
Exhaust clearance (before)	0.019 inch	0.020 inch	0.021 inch	0.020 inch	0.019 inch	0.020 inch.
Exhaust clearance (after)	0.004 inch	0.007 inch	None	0.007 inch	0.010 inch	0.019 inch.

It is interesting to note the slight variation in clearance that took place in the inlet valve timing and clearances. The decreased clearances on the exhaust valves with a consequent greater period of valve opening had practically no effect on the power output as will be noted on the log sheets.

The magneto timing was set at 30° advance. The wear at the magneto drive coupling reduced the advance to 28° at the finish of the run. This decrease was due to wear which occurred on the squared portion of the female member of the coupling assembly. No wear took place at the serrations.

ANALYSIS.

This engine made an excellent showing on the test. No forced stops were made and the power output was very uniform. The speed and power at the finish of the tenth period remained as uniform as it was during any of the other periods. The fuel and oil consumption on test was very good. The oil pressure was changed twice during the test. An increase in pressure did not materially increase the consumption, as will be noted on the log.

The condition of the main and connecting rod bearings was excellent after a run of this duration. The bearings were in such good condition that much more running would have been easily possible.

Several cams showed undue wear. This was found to be due to dirt lodging in the oil holes which are drilled through the faces of the cams. Insufficient lubrication at these points resulted in undue wear on the corresponding cam followers.

The magneto couplings developed undue wear which resulted in backlash considerably in excess of that which was present at the beginning.

The cylinder construction is not very sound thermally, as the condition of the valves showed, since it requires heat conduction through metal surfaces not held rigidly in contact. This could be improved by the provision of means to insure a better contact between the steel barrel and the aluminum jacket and a thicker combustion chamber head. An alternative and perhaps more satisfactory construction would be such as is used in the B. H. P. engine in which the barrel is of steel but open at the combustion chamber end, permitting a combustion chamber of aluminum in which the heat has only one metal to pass through to the cooling water. In this construction the valve seats are of bronze "expanded" in with a tool similar to that used in expanding boiler tubes.

The valve gear requires care in assembly, and once assembled the clearances can not be adjusted without removal of the entire cam shaft assembly. In this connection it is well to note the change in tappet clearances (and consequently in timing) which occurs after extended running. (See tear-down inspection.)

RECOMMENDATIONS.

The following changes are recommended in future engines of this model:

(*a*) Increase diameter of crank-pin oil plug bolts. The present ones appear too light, which might cause undue stretching with a consequent loosening of the plug in its seat.

(*b*) Increase size of engine to engine-bearer hold down bolts and holes. These bolts did not work loose or break, but a larger size is considered advisable. Provide castellated nuts on oil pump case studs. Also provide castellated nuts on water pump studs.

(*c*) The thickness of the web of the connecting rod can be decreased, thereby cutting down the weight without undue sacrifice of strength.

(*d*) Increase thickness of combustion chamber heads and, if practicable, improve contact with aluminum jackets by means of two studs. If studs can not be used, heads should be fitted to bear first at the center between the valves. The cylinder valve ports could be cleaned up by shortening up on the valve stem guides which project into the ports on one end. Also recommend placing the spark plugs 180° apart and at right angles to the crankshaft center lines.

(*e*) A good quality sheet cork gasket should be placed between the cam-shaft housing and the cylinder head. The cam followers should be shortened to eliminate the tendency to pump oil. This pumping action is perhaps caused by the follower passing over the gasket. It may be of advantage to increase the size of the oil holes in the face of the cams and the size of the oil passage into the cam shaft in order to reduce possibility of oil holes in cams becoming plugged.

(*f*) Counterbore the crankshaft gear to prevent starter marring the splines and make the splines even.

(*g*) The magneto coupling design should be improved to eliminate the tendency to wear. If the square type of drive is retained, the area of the female and male members should be increased and carefully hardened.

50-HOUR LOG OF TEST
STOPS DURING TEST
1 2 3 4 5 6 7 8 9 10
REVOLUTIONS PER MINUTE OF ENGINE
BRAKE HORSE POWER
FUEL CONSUMPTION LB. PER H.P. HR.
OIL CONSUMPTION LB. PER HR.
1700
1600
550
500
450
170
160
150
140
3.0
2.0
1.0
0
0 5 10 15 20 25 30 35 40 45 50
RAUSIE E-6
ELAPSED TIME-HOURS

FIG. 1.

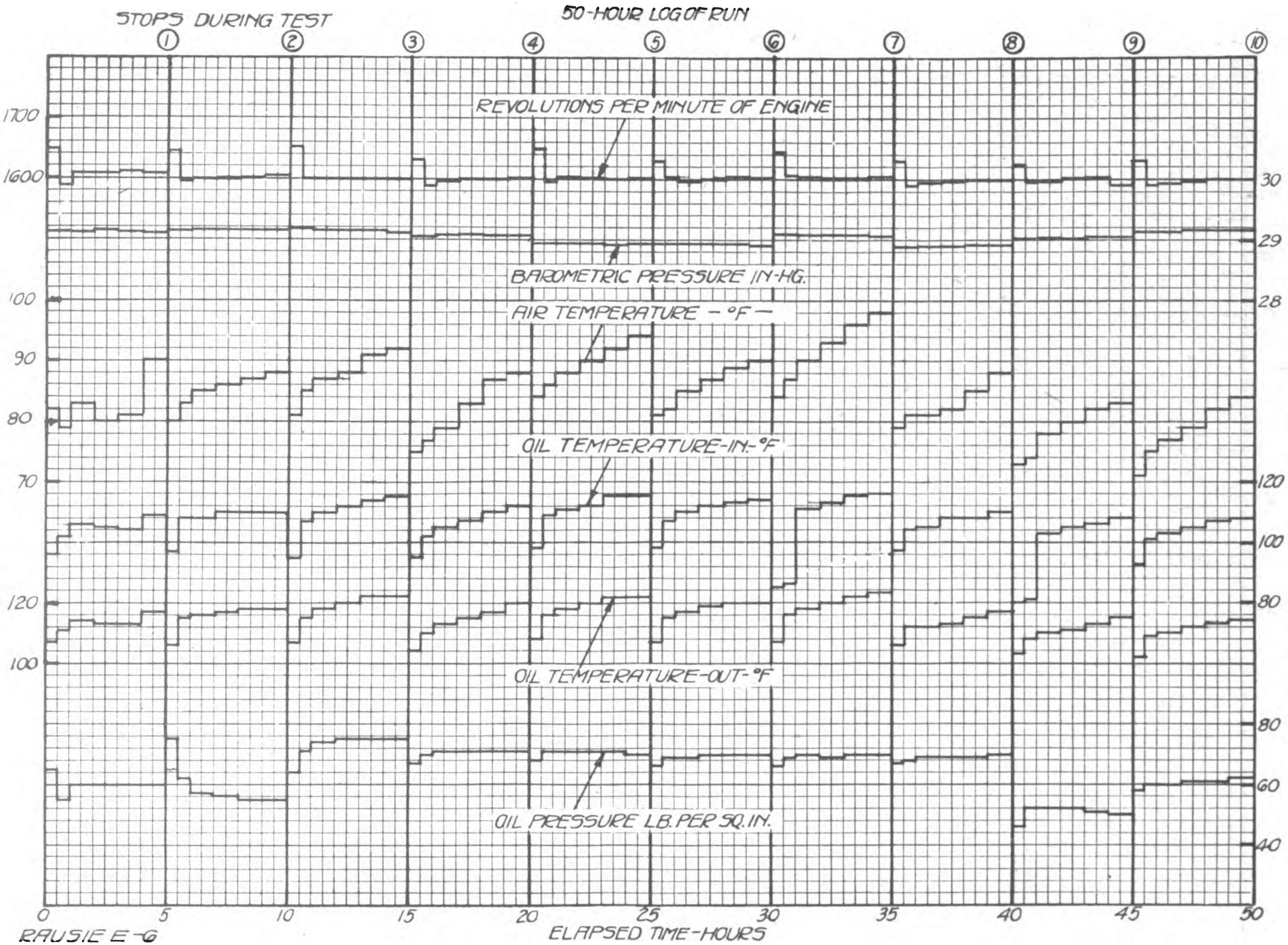

50-HOUR LOG OF RUN
STOPS DURING TEST
1 2 3 4 5 6 7 8 9 10
REVOLUTIONS PER MINUTE OF ENGINE
BAROMETRIC PRESSURE IN-HG.
AIR TEMPERATURE - °F -
OIL TEMPERATURE-IN-°F
OIL TEMPERATURE-OUT-°F
OIL PRESSURE LB. PER SQ. IN.
1700
1600
100
90
80
70
120
100
30
29
28
120
100
80
80
60
40
0 5 10 15 20 25 30 35 40 45 50
ELAPSED TIME-HOURS
RAUSIE E-6

FIG. 2.

Average of averages of first half hour runs (Rausie E-6).

FULL THROTTLE.

R. P. M. of engine.	B. H. P.	Air temp. °F.	Bar. In./Hg.	Water. Temp., °F. In.	Water. Temp., °F. Out.	Oil. Temp., °F. In.	Oil. Temp., °F. Out.	Oil. Press., lb. per sq. in.	Man. vac., in. Hg.	Fuel cons. Lb. per hr.	Fuel cons. Lb. per hp. hr.	Oil cons. Lb. per hr.
1,638	162.2	79	29.05	142	150	93	105	64	1.4	79.0	.487	2.4

Average of averages of last four and one-half hour runs.

PARTIAL THROTTLE.

1,600	150.8	85	29.05	143	150	108	116	65	2.0	76.8	.506	1.5

Table of average results.

Date.	Time. Total elapsed. Hr.	Time. Total elapsed. Min.	Time. Duration this run. Hr.	Time. Duration this run. Min.	R. P. M. of engine.	B. H. P.	Carb. air, Temp., °F.	Bar., in. Hg.	Water. Temp., °F. In.	Water. Temp., °F. Out.	Oil. Temp., °F. In.	Oil. Temp., °F. Out.	Oil. Press., lb. per sq. in.	Man. vac., in. Hg.	Carb. vac., in. Hg.	Fuel Cons. Lb. per hr.	Fuel Cons. Lb. per hp. hr.	Oil cons., lb. per hr.
July 8, 1921 ..	0	30	0	30	[1] 1,648	165.0	82	29.12	142	150	96	107	65	1.4	1.6	82.0	0.497	2.6
	1	00	0	30	1,587	147.0	79	29.12	143	150	102	111	55	2.1	1.3	74.5	.507	2.6
	2	00	1	00	1,607	152.5	83	29.11	143	150	106	114	60	1.9	1.3	77.8	.510	1.8
	3	00	1	00	1,607	152.5	80	29.12	142	150	105	113	60	1.9	1.3	79.3	.520	1.8
	4	00	1	00	1,610	153.5	81	29.10	144	151	104	113	60	2.0	1.3	76.3	.497	1.6
	5	00	1	00	1,608	153.0	90	29.09	143	150	109	117	60	2.0	1.3	77.0	.503	1.6
Stop—End of first period.																		
July 11, 1921 .	5	30	0	30	[1] 1,643	163.5	80	29.13	143	151	97	106	75	1.4	....	80.5	0.492	3.0
	6	00	0	30	1,597	150.0	83	29.13	143	150	108	115	62	2.1	....	76.0	.506	.8
	7	00	1	00	1,600	151.0	85	29.14	143	150	108	116	57	2.1	....	76.5	.506	1.5
	8	00	1	00	1,600	151.0	86	29.14	143	150	110	117	56	2.1	....	78.0	.516	1.3
	9	00	1	00	1,601	151.2	87	29.14	143	150	110	118	55	2.1	....	78.0	.516	1.7
	10	00	1	00	1,603	151.5	88	29.14	143	151	110	118	55	2.1	....	74.8	.493	1.6
Stop—End of second period.																		
July 12, 1921.	10	30	0	30	[1] 1,653	166.5	81	29.17	144	152	95	107	64	1.5	....	80.5	0.483	2.6
	11	00	0	30	1,600	151.0	85	29.17	143	150	107	115	71	2.2	....	75.0	.497	1.2
	12	00	1	00	1,600	151.0	87	29.15	143	150	110	118	74	2.1	....	77.0	.510	1.8
	13	00	1	00	1,600	151.0	88	29.15	143	150	112	120	75	2.1	....	76.0	.503	1.8
	14	00	1	00	1,600	151.0	91	29.15	145	152	114	122	75	2.0	....	77.0	.510	1.9
	15	00	1	00	1,600	151.0	92	29.12	143	150	115	122	75	2.1	....	73.3	.485	1.7
Stop—End of third period.																		
July 13, 1921 .	15	30	0	30	[1] 1,633	160.5	75	29.04	143	151	95	104	67	1.4	....	80.0	0.498	2.2
	16	00	0	30	1,589	148.0	77	29.04	142	149	102	110	70	2.2	....	75.0	.506	1.4
	17	00	1	00	1,597	150.0	79	29.06	143	150	105	113	71	2.0	....	76.8	.512	1.6
	18	00	1	00	1,600	151.0	83	29.07	143	151	107	115	71	2.0	....	77.8	.515	1.6
	19	00	1	00	1,600	151.0	87	29.06	142	150	110	117	71	2.1	....	77.3	.512	1.8
	20	00	1	00	1,601	151.2	88	29.06	142	150	112	120	71	2.2	....	74.0	.490	1.8
Stop—End of fourth period.																		

[1] One-half hour full throttle runs.

Table of average results—Continued.

Date.	Time. Total elapsed. Hr.	Time. Total elapsed. Min.	Time. Duration this run. Hr.	Time. Duration this run. Min.	R. P. M. of engine.	B. H. P.	Carb. air Temp., °F.	Bar. in. Hg.	Water. Temp., °F. In.	Water. Temp., °F. Out.	Oil. Temp., °F. In.	Oil. Temp., °F. Out.	Oil. Press., lb. per sq. in.	Man. vac., in. Hg.	Carb. vac., in. Hg.	Fuel Cons. Lb. per hr.	Fuel Cons. Lb. per hp. hr.	Oil cons., lb. per hr.
July 14, 1921	20	30	0	30	[1] 1,650	165.5	84	28.96	141	150	98	108	68	1.4	....	78.5	0.474	2.8
	21	00	0	30	1,598	150.5	86	28.96	142	150	109	116	71	2.2	....	74.0	.491	1.0
	22	00	1	00	1,602	151.5	88	28.96	142	150	111	118	71	2.1	....	76.3	.503	1.4
	23	00	1	00	1,601	151.2	90	28.96	142	150	112	120	71	2.1	....	76.0	.502	1.7
	24	00	1	00	1,600	151.0	92	28.95	142	150	115	122	71	2.0	....	75.3	.498	1.7
	25	00	1	00	1,601	151.2	94	28.96	143	151	115	122	70	2.1	....	75.0	.496	1.7
Stop—End of fifth period.																		
July 15, 1921	**25**	**30**	**0**	**30**	**[1] 1,631**	**160.0**	**81**	**28.96**	**141**	**150**	**98**	**107**	**66**	**1.4**	....	**76.5**	**0.478**	**2.8**
	26	**00**	**0**	**30**	**1,602**	**151.5**	**82**	**28.96**	**142**	**150**	**107**	**115**	**69**	**2.0**	....	**75.5**	**.498**	**1.2**
	27	**00**	**1**	**00**	**1,598**	**150.5**	**85**	**28.96**	**143**	**151**	**110**	**117**	**69**	**2.0**	....	**76.5**	**.508**	**.4**
	28	**00**	**1**	**00**	**1,599**	**150.8**	**87**	**28.96**	**142**	**151**	**112**	**119**	**70**	**2.0**	....	**78.0**	**.517**	**.7**
	29	**00**	**1**	**00**	**1,602**	**151.5**	**89**	**28.96**	**142**	**150**	**113**	**120**	**70**	**2.0**	....	**76.0**	**.501**	**1.8**
	30	**00**	**1**	**00**	**1,601**	**151.2**	**90**	**28.94**	**142**	**150**	**114**	**120**	**70**	**2.0**	....	**76.3**	**.504**	**1.9**
Stop—End of sixth period.																		
July 18, 1921	**30**	**30**	**0**	**30**	**[1] 1,646**	**164.5**	**84**	**29.09**	**142**	**150**	**85**	**107**	**66**	**1.4**	....	**76.0**	**0.462**	**2.2**
	31	**00**	**0**	**30**	**1,605**	**152.0**	**87**	**29.09**	**144**	**152**	**86**	**116**	**69**	**2.2**	....	**75.5**	**.497**	**1.4**
	32	**00**	**1**	**00**	**1,603**	**151.5**	**90**	**29.08**	**140**	**148**	**111**	**118**	**70**	**2.1**	....	**75.5**	**.498**	**1.7**
	33	**00**	**1**	**00**	**1,601**	**151.2**	**93**	**29.08**	**142**	**150**	**113**	**120**	**69**	**2.2**	....	**75.5**	**.499**	**1.8**
	34	**00**	**1**	**00**	**1,601**	**151.2**	**96**	**29.08**	**141**	**149**	**115**	**122**	**70**	**2.2**	....	**73.3**	**.485**	**1.9**
	35	**00**	**1**	**00**	**1,602**	**151.5**	**98**	**29.07**	**142**	**150**	**116**	**123**	**70**	**2.2**	....	**75.3**	**.497**	**1.9**
Stop—End of seventh period.																		
July 19, 1921	**35**	**30**	**0**	**30**	**[1] 1,629**	**159.0**	**79**	**28.88**	**144**	**151**	**97**	**106**	**67**	**1.4**	....	**75.5**	**0.475**	**1.8**
	36	**00**	**0**	**30**	**1,592**	**148.5**	**81**	**28.88**	**143**	**151**	**104**	**112**	**68**	**1.9**	....	**76.0**	**.512**	**1.6**
	37	**00**	**1**	**00**	**1,596**	**150.0**	**81**	**28.90**	**143**	**151**	**105**	**112**	**69**	**1.9**	....	**76.8**	**.512**	**1.6**
	38	**00**	**1**	**00**	**1,598**	**150.5**	**82**	**28.90**	**143**	**151**	**108**	**113**	**69**	**1.8**	....	**78.0**	**.518**	**1.6**
	39	**00**	**1**	**00**	**1,600**	**151.0**	**85**	**28.92**	**143**	**150**	**108**	**115**	**69**	**1.9**	....	**76.0**	**.503**	**1.6**
	40	**00**	**1**	**00**	**1,600**	**151.0**	**88**	**28.92**	**143**	**151**	**110**	**117**	**70**	**1.9**	....	**76.0**	**.503**	**1.7**
Stop—End of eighth period. Oil pressure decreased.																		
July 20, 1921	**40**	**30**	**0**	**30**	**[2] 1,625**	**158.0**	**73**	**29.01**	**143**	**150**	**80**	**103**	**46**	**1.4**	....	**80.5**	**0.509**	**2.0**
	41	**00**	**0**	**30**	**1,596**	**150.0**	**74**	**29.01**	**143**	**150**	**81**	**108**	**52**	**1.8**	....	**76.5**	**.510**	**1.2**
	42	**00**	**1**	**00**	**1,597**	**150.5**	**78**	**29.01**	**142**	**150**	**103**	**110**	**52**	**1.8**	....	**77.8**	**.517**	**1.4**
	43	**00**	**1**	**00**	**1,601**	**151.2**	**80**	**29.01**	**143**	**150**	**105**	**111**	**52**	**1.8**	....	**79.5**	**.526**	**1.4**
	44	**00**	**1**	**00**	**1,602**	**151.5**	**82**	**29.02**	**144**	**151**	**106**	**113**	**51**	**1.8**	....	**77.3**	**.510**	**1.5**
	45	**00**	**1**	**00**	**1,594**	**149.0**	**83**	**29.02**	**142**	**150**	**108**	**115**	**50**	**1.8**	....	**77.5**	**.520**	**1.6**
Stop—End of ninth period—Oil pressure increased.																		
July 21, 1921	**45**	**30**	**0**	**30**	**[2] 1,631**	**160.0**	**71**	**29.14**	**142**	**150**	**93**	**102**	**58**	**1.4**	....	**80.0**	**0.500**	**1.8**
	46	**00**	**0**	**30**	**1,592**	**148.5**	**75**	**29.14**	**141**	**149**	**101**	**109**	**60**	**1.6**	....	**76.5**	**.515**	**1.0**
	47	**00**	**1**	**00**	**1,595**	**149.5**	**77**	**29.14**	**143**	**150**	**103**	**110**	**60**	**1.8**	....	**78.0**	**.522**	**1.3**
	48	**00**	**1**	**00**	**1,597**	**150.2**	**79**	**29.15**	**142**	**150**	**105**	**112**	**61**	**1.8**	....	**79.5**	**.529**	**1.4**
	49	**00**	**1**	**00**	**1,600**	**151.0**	**82**	**29.15**	**142**	**150**	**107**	**114**	**61**	**1.8**	....	**77.3**	**.512**	**1.5**
	50	**00**	**1**	**00**	**1,600**	**151.0**	**84**	**29.15**	**143**	**150**	**108**	**115**	**62**	**1.9**	....	**77.3**	**.512**	**1.4**
	51	**00**	**1**	**00**	**[2] 1,626**	**158.2**	**85**	**29.13**	**141**	**150**	**110**	**116**	**62**	**1.4**	....	**81.5**	**.516**	**1.6**
	51	**15**	**0**	**15**	**[2] 1,633**	**160.5**	**86**	**29.13**	**163**	**[3] 170**	**110**	**118**	**62**	**1.4**	....	**80.0**	**.498**	**1.2**

Stop—End of test.

[1] One-half hour full throttle runs.
[2] Full throttle runs.
[3] The outlet water temperature was raised to 170° to determine the effect of increased water temperature on the heating of the valves. No bad effect noted, rather a slight improvement observed in power output.

The engine was run one hour over the regular 50 hours, the fifty-first hour being run at full throttle full power.

The acceleration, idling, and starting at the finish of the test were very good.

Calibration and friction H. P. runs on dynamometer.

R. P. M. of engine.	Actual.			Corrected.			Water.		Oil.			Carb. air, temp., ° F.	Man. vac., in. Hg.	Carb. vac., in. Hg.	Fuel cons.	
	Brake load, lb.	Torque, lb./ft.	B. H. P.	Torque, lb./ft.	H. P.	B.M.E. P., lb. per sq. in.	Temp., ° F. In.	Temp., ° F. Out.	Temp., ° F. In.	Temp., ° F. Out.	Press., lb. per sq. in.				Lb. per hr.	Lb. per hp. hr.
1,240	286	500.8	118.2	519.0	122.5	110.7	145	162	110	112	48	94	0.6	0.65	59.4	0.502
1,350	286	500.8	128.7	519.0	133.4	110.7	146	160	114	118	50	94	.7	.7	64.3	.499
1,440	287	502.2	137.7	521.0	142.7	111.2	146	160	116	120	50	96	.9	.9	69.2	.501
1,550	296	518.0	152.9	537.0	158.5	114.5	146	160	120	124	52	98	.9	1.0	76.1	.498
1,660	290	507.7	160.5	526.0	166.4	112.3	146	160	120	124	54	97	1.0	1.0	82.5	.514
1,740	284	497.0	164.7	515.3	170.7	110.0	144	160	122	125	55	95	1.3	1.1	85.0	.516
1,850	274	479.5	168.9	497.0	175.0	106.0	148	160	124	127	55	96	1.5	1.15	88.6	.525
1,950	259	453.4	168.4	470.0	174.5	100.3	147	160	125	130	56	96	1.7	1.2	92.4	.549

Bad oil leaks between cam-shaft housing and cylinder heads.
Length of brake arm, 21 inches; kind of oil used, U. S. Spec. 2-23b; specific gravity of fuel, .715 at 60° F.; average barometer, 28.88 in. Hg.

R. P. M. by tachometer.	Corrected engine B. H. P. from curve.	Friction load in pounds.	F. H. P.	Per cent mechanical efficiency.	Comp. press., lb. per sq. in.	Temperatures ° F.				
						Water. In.	Water. Out.	Oil. In.	Oil. Out.	Air.
1,230	121.7	28	11.5	91.4	....	162	162	128	132	96
1,340	132.5	34	15.2	89.8	....	160	162	128	130	96
1,430	143.5	43	20.5	87.6	....	158	160	128	132	94
1,540	156.0	45	23.1	87.2	....	158	160	127	132	94
1,650	165.5	50	27.5	85.8	....	158	160	126	132	94
1,750	171.5	52	30.3	85.0	....	158	160	126	130	93
1,840	174.2	54	33.1	84.0	....	160	162	126	130	94
1,960	174.8	56	36.6	82.7	....	160	162	128	132	94

Carburetors used, Stromberg NA-S5; chokes, 1½ inches; main jets, No. 50 drill size; flow, 44 pints per hour.
Length of brake arm, 21 inches; kind of oil used, U. S. Spec. 2-23b; average barometer, 28.88 in. Hg.

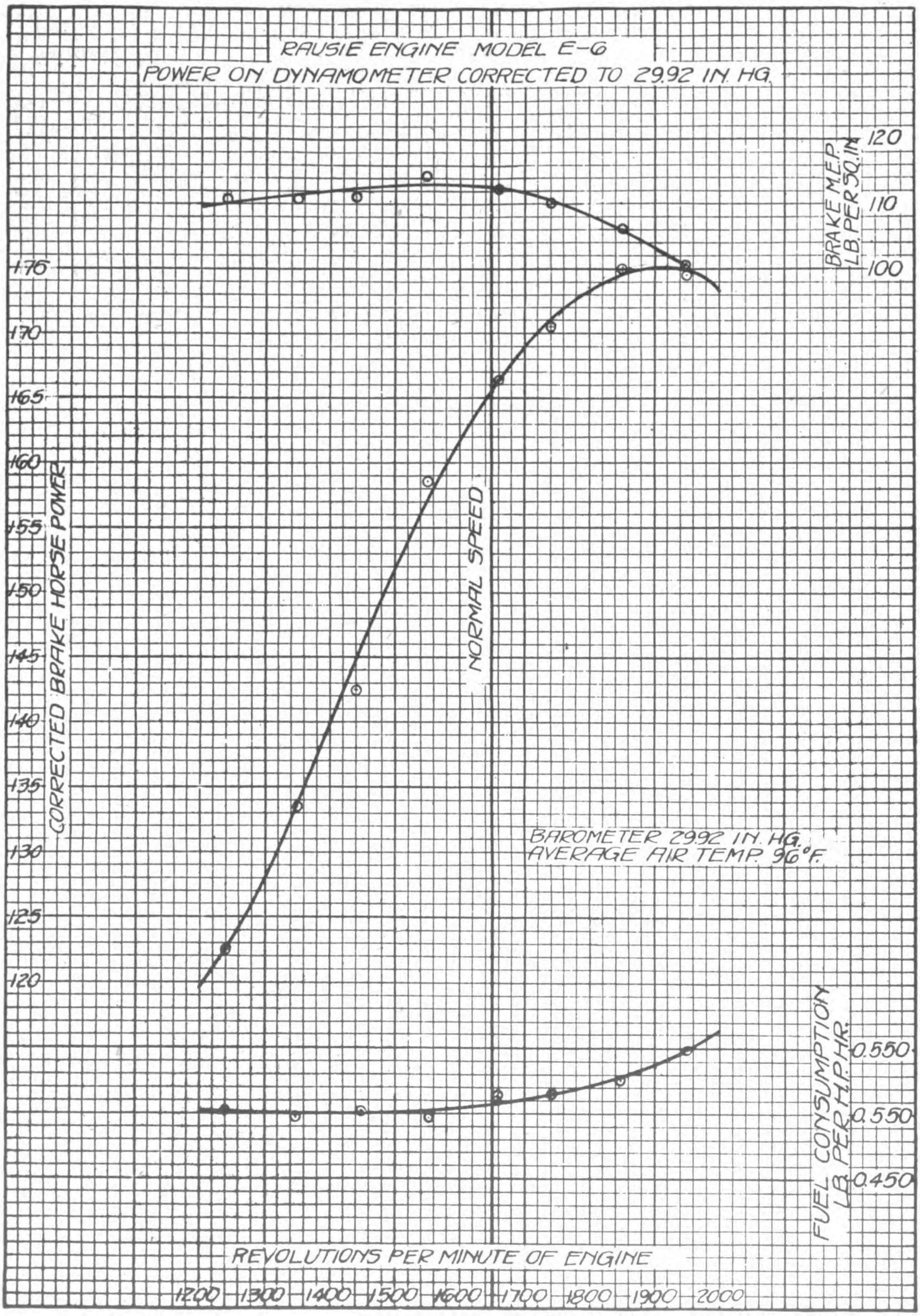

RAUSIE ENGINE MODEL E-6
POWER ON DYNAMOMETER CORRECTED TO 29.92 IN. HG.
BRAKE M.E.P. LB. PER SQ. IN.
120
110
100
175
170
165
160
155
150
145
140
135
130
125
120
CORRECTED BRAKE HORSE POWER
NORMAL SPEED
BAROMETER 29.92 IN. HG.
AVERAGE AIR TEMP. 96°F.
FUEL CONSUMPTION LB. PER H.P. HR.
0.550
0.550
0.450
REVOLUTIONS PER MINUTE OF ENGINE
1200
1300
1400
1500
1600
1700
1800
1900
2000

Fig. 3.

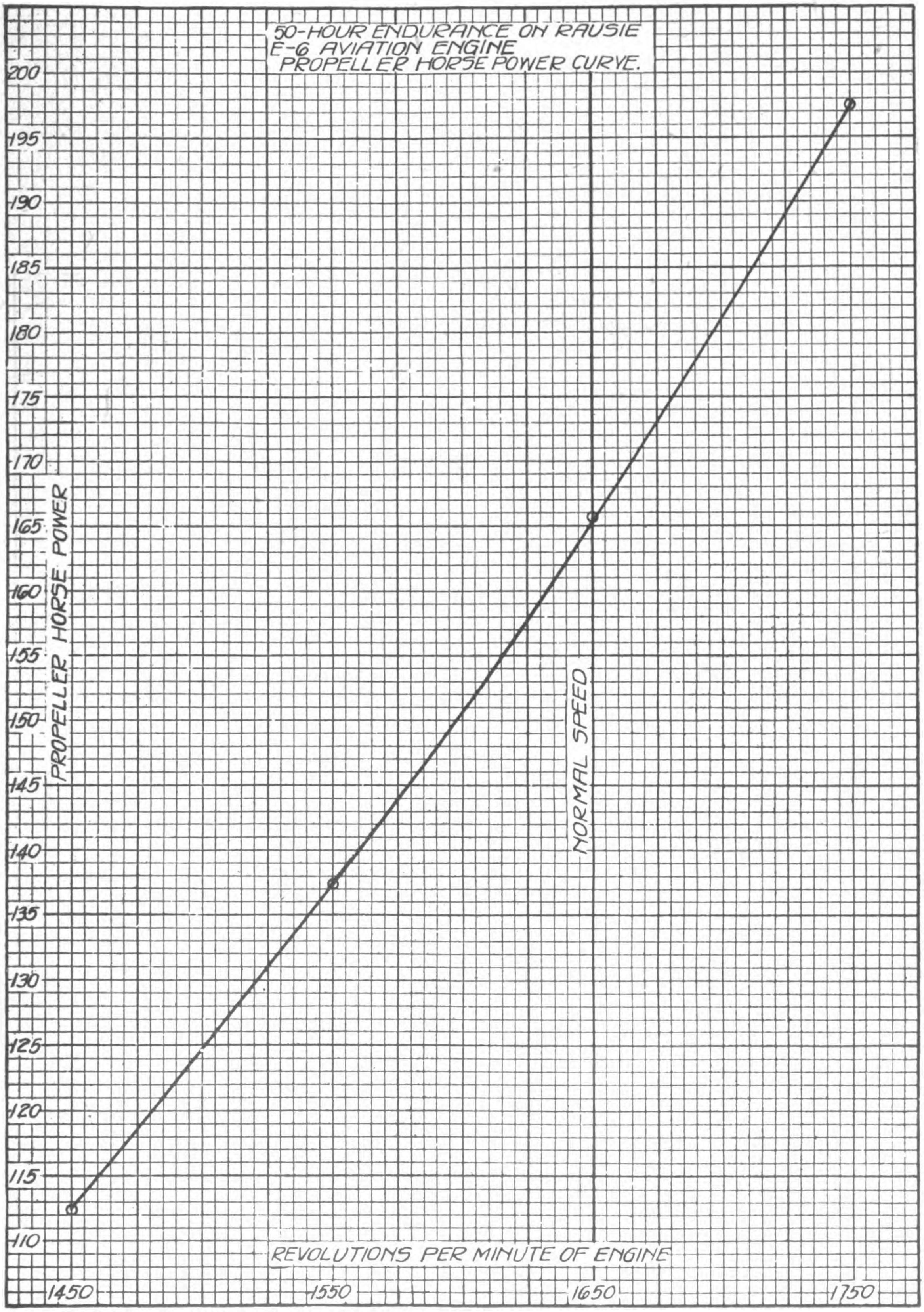

50-HOUR ENDURANCE ON RAUSIE
E-6 AVIATION ENGINE
PROPELLER HORSE POWER CURVE.
PROPELLER HORSE POWER
NORMAL SPEED
REVOLUTIONS PER MINUTE OF ENGINE
200
195
190
185
180
175
170
165
160
155
150
145
140
135
130
125
120
115
110
1450
1550
1650
1750

FIG. 4.

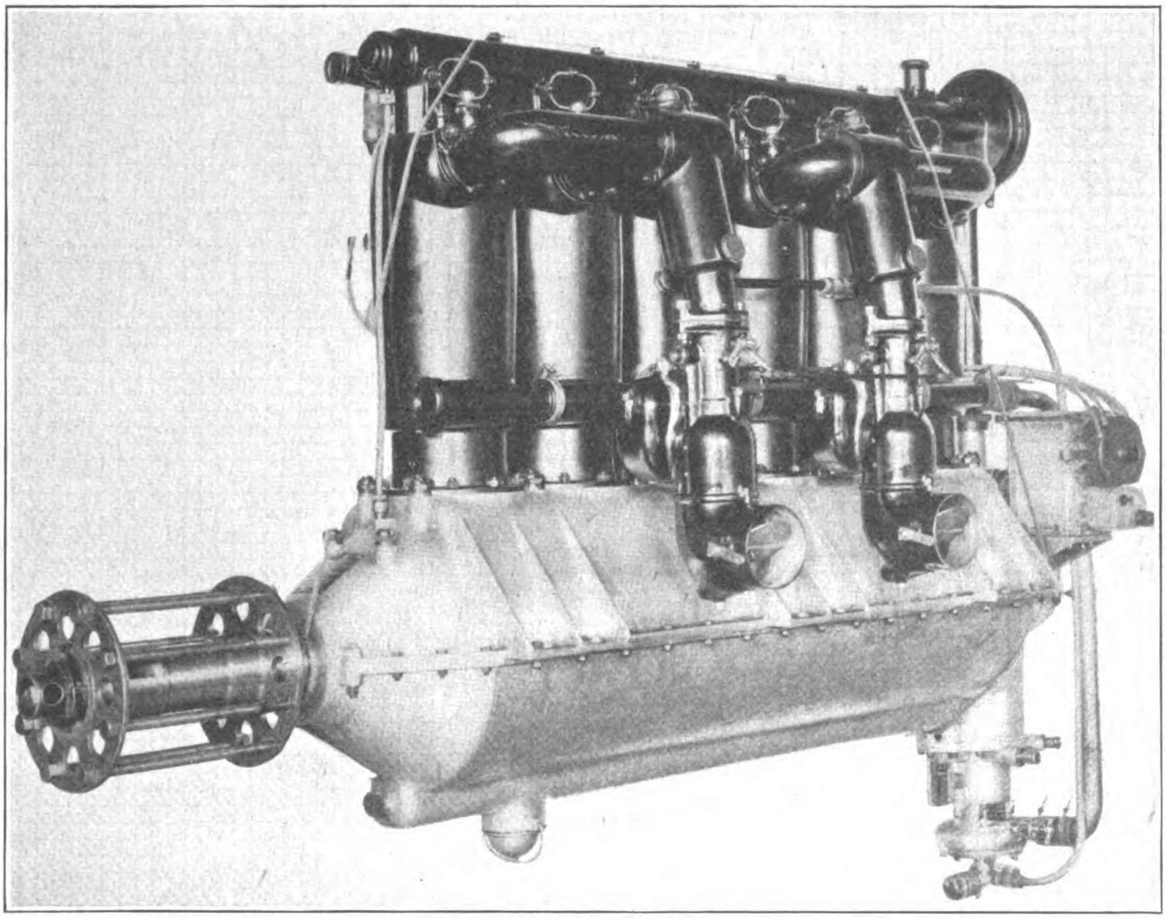


Fig. 5.—Three-quarter front view of engine.

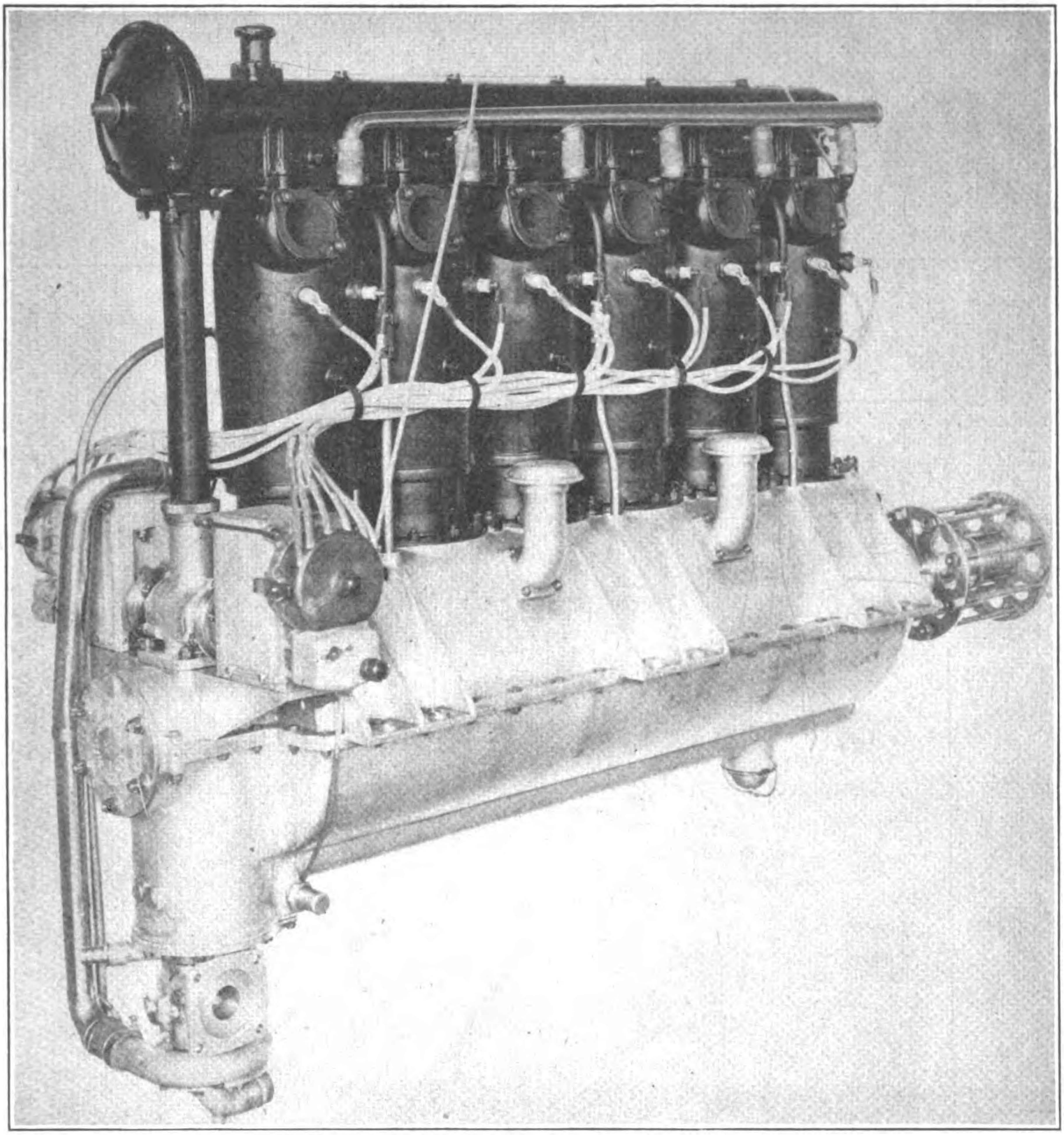


FIG. 6.—Three-quarter rear view of engine.

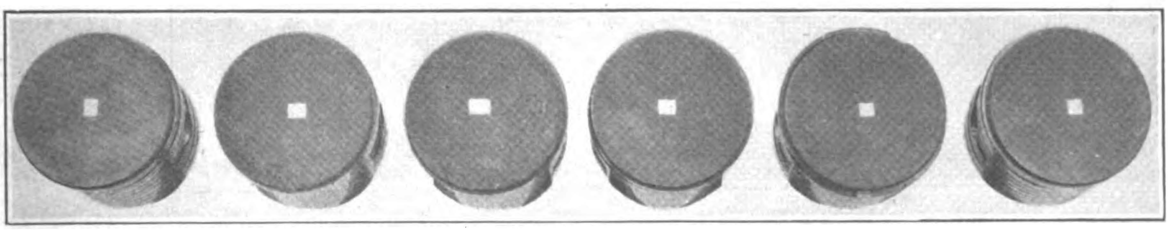


FIG. 7.—Pistons after finish of test.

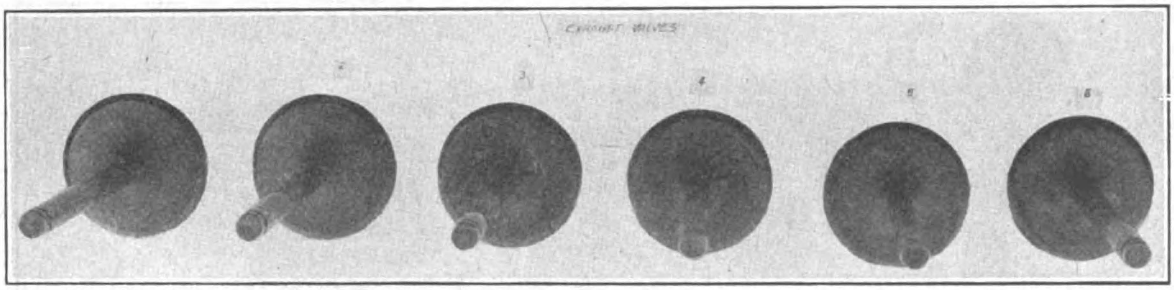


FIG. 8.—Exhaust valves after finish of 50-hour test.

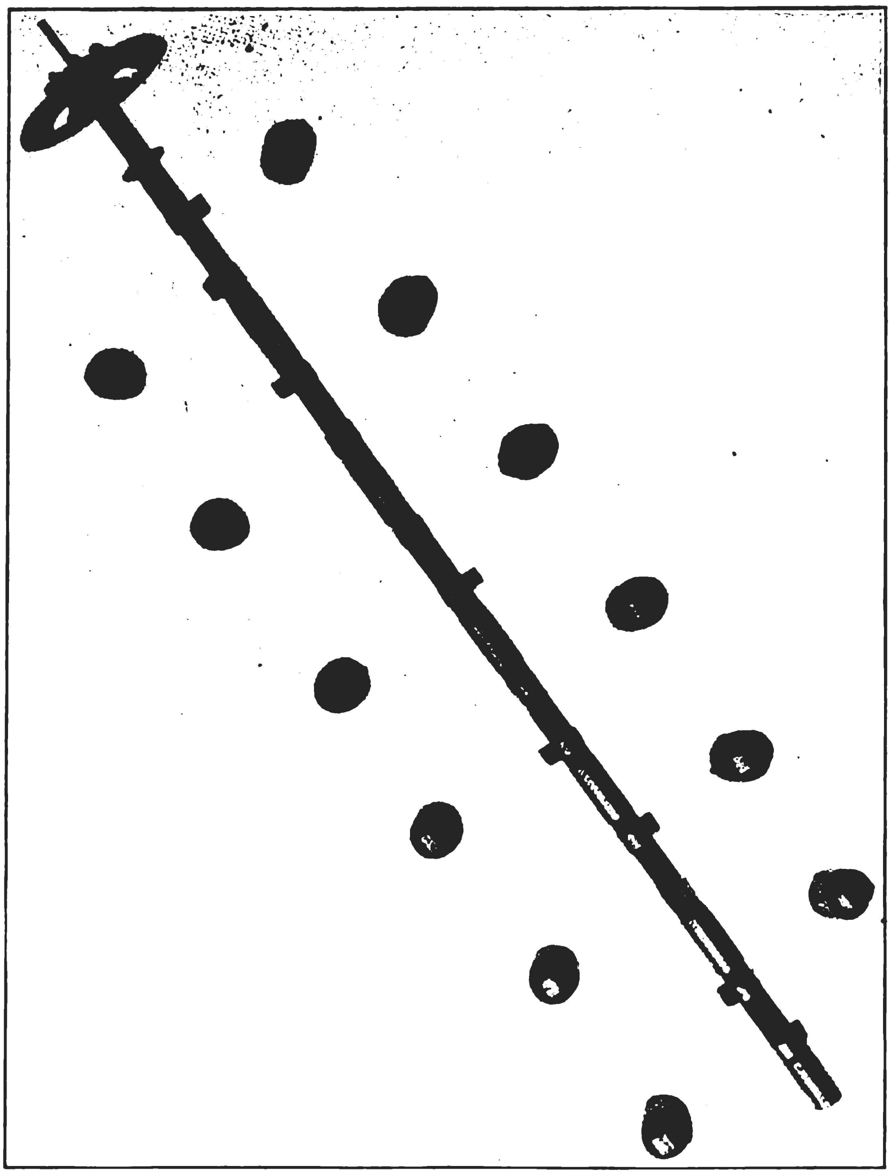


FIG. 9.—Camshaft and cam followers after 50-hour test. Note wear on No. 6 cam follower.

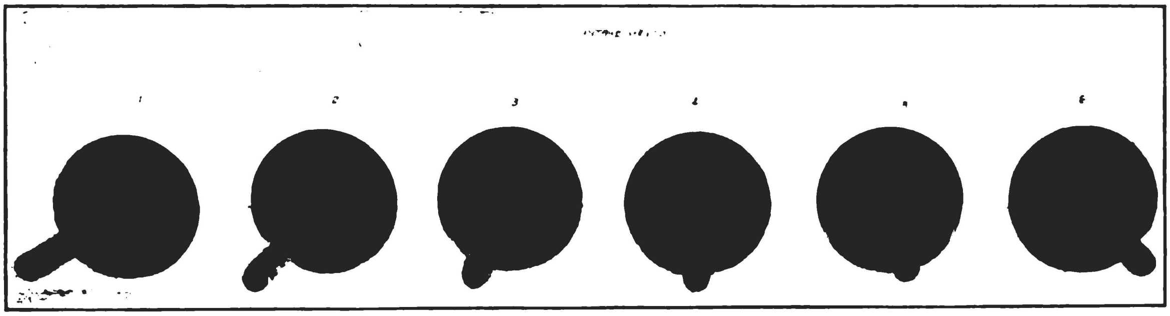


FIG. 10.—Intake valves after 50-hour test. Note the heavy hydrocarbon compound deposits on under side of valves.

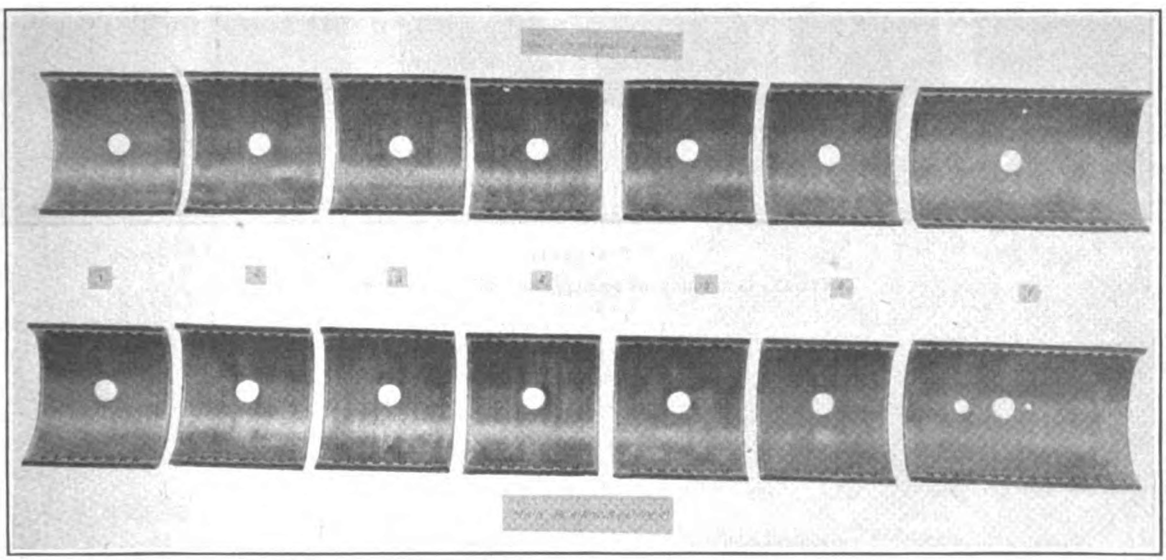
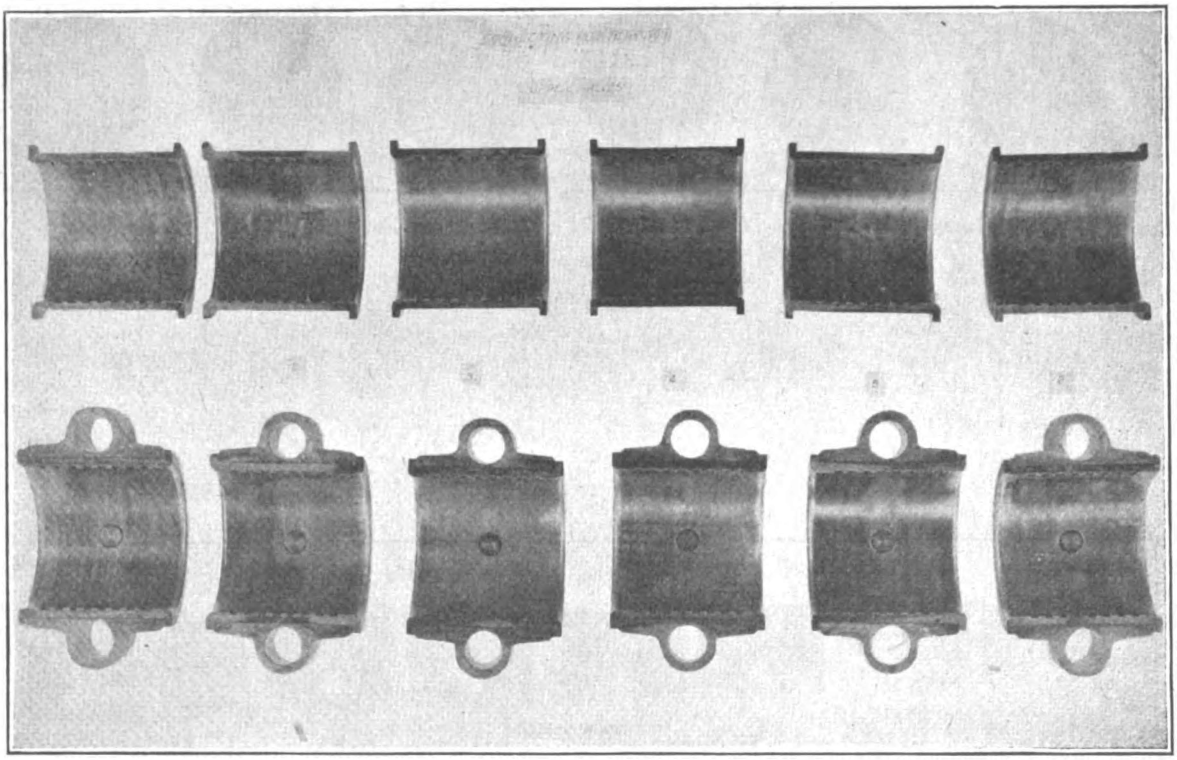


FIG. 11.—Main bearings after 50-hour endurance test.



Lower halves.

Fig. 12.—Connecting rod bearings after 50-hour endurance test.